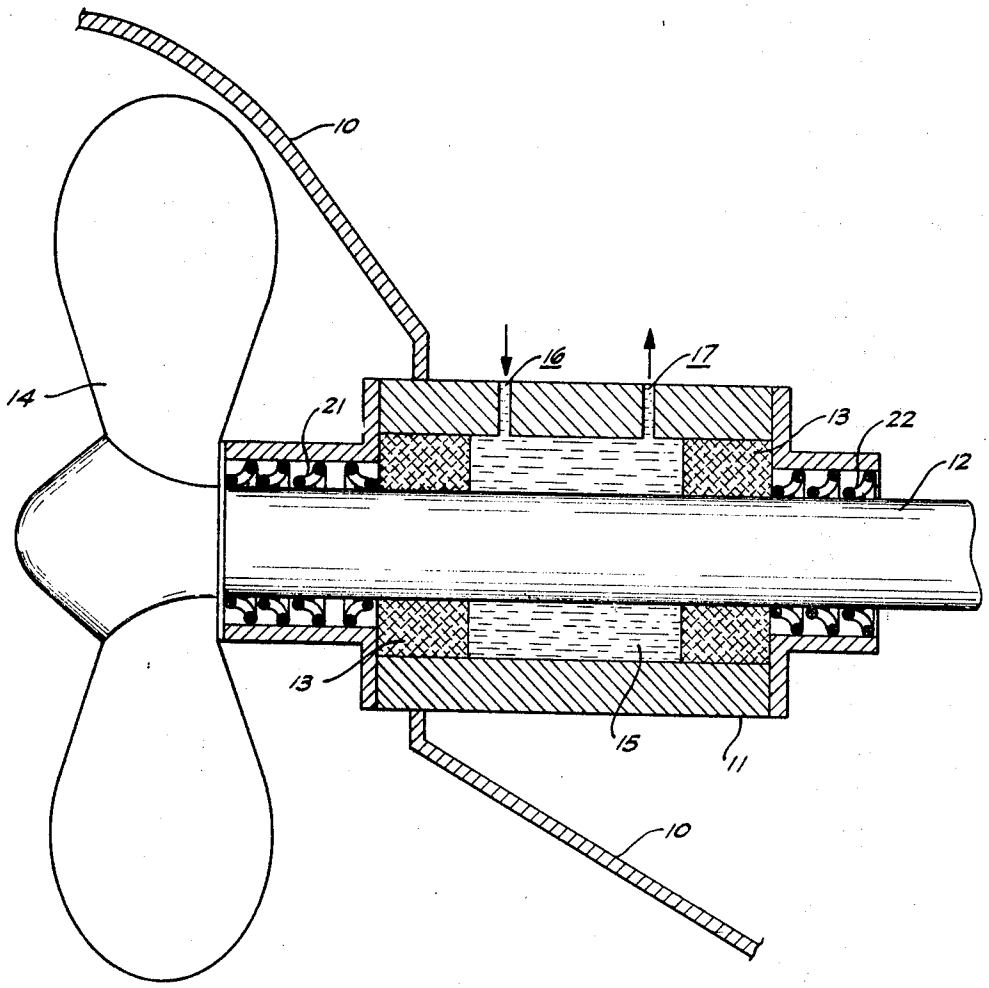
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REPLACEMENT OF UNDERWATER SEALS

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REPLACEMENT OF UNDERWATER SEALS

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ABSTRACT OF THE DISCLOSURE

Lubricating seals for underwater use such as vessels are replaced underwater by gelling the oil in the stern tube. This permits replacement of the seals without entry of sea water into the tube. The gel is then broken and removed followed by an oil change.

This invention relates to the replacement of lubricating seals underwater, and more particularly to the replacement of stern tube seals in vessels.

A critical part in the drive assembly of ocean going vessels is the stern tube through which the propeller shaft passes from the hull into the water. The stern tube at both ends houses bearings to support the shaft, and since it is located far below the water line, the stern tube is provided with shaft seals to keep out the sea water. For lubrication and cooling purposes oil is circulated through the annular space between the propeller shaft and the stern tube at pressures approximately equal to the sea water head at the stern tube level. The shaft seals which are installed at the after end of the housing will keep out sea water while those at the forward end will contain the circulating oil.

Athough the rotational speed of the shaft is slow, the peripheral speed of the shaft is high due to its large diameter; hence considerable heat is generated at the support bearings and at the seals. Because of heat generation and wear, the seals eventually wear out and must be replaced. Underwater replacement is not feasible because the sea water would simply enter into the stern tube; consequently, the ship must be drydocked for seal replacement. This is an expensive operation both from the standpoint of drydock handling and particularly due to time lost from shipping service.

Accordingly, it is an object of this invention to provide a method of replacing lubricating seals underwater.

Another object is to provide a method of replacing stern tube seals in vessels.

Other objects of the invention will be disclosed from the description to follow.

The objects of the invention are attained by forming a water resistant gel in the stern tube assembly. This permits replacement of the stern seals underwater without the attendant problem of water entering the stern tube. When the seals have been replaced, the gel is broken and preferably removed; finally oil is circulated back into the system and the vessel is ready for use again. Preferably the system is flushed with solvents after the gel has been broken, followed by refilling with fresh oil.

The invention is illustrated in the diagram which shows a stern tube assembly mounted on a vessel hull **10**. The assembly comprises a stern tube housing **11**, mounting a propeller shaft **12**, on bearings **13**, the shaft having a propeller **14**, at its end. A space **15** is provided between the stern tube **11** and shaft **12**; lubrication for the bearings **13** is provided by circulating oil through a passageway **16**, in the stern tube and then into the space **15**, and the bearings. The oil is recirculated by removing it through passageway **17** in the stern tube, followed by filtering and cooling. An outboard seal assembly **21**, and an inboard

seal assembly **22**, are mounted on the shaft at either end of the stern tube assembly to seal it from the entrance of sea water and the escape of oil.

When the seals are to be replaced, a gelling agent is injected into the stern tube space **15**, to displace the lubricating oil and the gelling agent is then permitted to set up. The outboard seal is then conveniently removed by an underwater diver, and the inboard seals are removed from inside the ship. New seals are then installed, the gel is broken by injecting an appropriate anti-gelling agent, the residue is removed by flushing, and fresh oil is recirculated into the system.

In many cases the inboard seal is a split seal which could be removed without uncoupling the shaft. However, if a continuous circle seal is employed, the shaft must be uncoupled and displaced rearwards; the new seals are then placed over the exposed end. Because of thrust forces on the shaft due to the sea water pressure head and possible currents, equipment (not shown) is required to both hold and move the shaft when it is disconnected from the thrust bearing.

When the new seals have been installed and the shaft reconnected, the gel is destroyed and the residue is removed. Fresh oil is finally recirculated into the system and the vessel is ready again for service.

One suitable agent for gelling the oil may be prepared as follows:

(1) A "Rosin Compound" is prepared by dissolving one part by weight of rosin ("M" grade) in one part by weight of 100 Gulf Coast Oil (or a low viscosity, low V.I. mineral oil of about 100 SUS at 100° F.). Agitation at about 150°–200° F. speeds the solution.

(2) A "Rosin Mix" compound is prepared by stirring the following at about 130° F.:

(a) 10 parts by weight "Rosin Compound."

(b) 22.5 parts by weight "Rosin Oil." (This is a relatively viscous fluid which represents the overhead from the distillation of rosin. It has a neutralization number of about 75 and generally contains about 55% of Rosin Acids.)

(c) 67.5 parts by weight 100 Gulf Coast Oil.

(3) A "Lime Mix" compound is prepared by making a uniform dispersion of:

(a) 12.5 parts by weight hydrated lime.

(b) 87.5 parts by weight 100 Gulf Coast Oil.

(4) To prepare a gel, equal weight of "Rosin Mix" (at 130° F.) and "Lime Mix" (at about 75° F.) are mixed thoroughly for approximately 20–30 seconds and then pumped into space **15** in which the oil is circulated, thereby displacing the oil. After a few minutes, the "Rosin Mix" and "Lime Mix" mixture will "set up" to a relatively heavy grease consistency. The seals may then be removed and replaced with a new set.

To destroy the gel, hot oil containing about 10% of oleic acid is circulated through the system; external heat such as steam heat may be applied where feasible. When the gel has broken down, it is removed by flushing with oil, and fresh oil is pumped into the oil circulation system.

Rather than injecting a gelling agent to displace the lubricating oil from space **15**, the lubricating oil may simply be drained out followed by replacement with a material which will form a water resistant gel in situ or with a water resistant grease.

Accordingly, it will be seen that the present method of removing stern seals can be accomplished without drydocking a vessel. This reduces the time a vessel must remain out of service and even permits replacement of the seals in a location where drydocking facilities are inadequate or unavailable, such as on the open seas.

We claim:

1. A method for replacing lubricating seals underwater which comprises forming a water resistant gel in

the lubricating space between the seals, removing and replacing the seals underwater, breaking the gel and filling the lubricating space with lubricating fluid.

2. A method for replacing lubricating seals in the stern tube of a vessel which comprises forming a water resistant gel in the space between the propeller shaft and stern tube, removing and replacing the seals, breaking and removing the gel, and filling the space with lubricating fluid.

3. The method of claim 2 in which the lubricating oil is drained from the space between the propeller shaft and stern tube and replaced with a water resistant grease or a material which will form a water resistant gel.

4. The method of claim 2 in which a material which will form a gel is introduced into the space between the propeller shaft and the stern tube thereby displacing lubricating fluid contained in the space.

5. The method of claim 2 in which the gel comprises equal parts by weight of "Rosin Mix" and "Lime Mix."

6. The method of claim 2 in which the gel is destroyed by circulating therethrough a hot oil containing oleic acid.

7. The method of claim 2 in which the gel residue is removed before the space is filled with lubricating oil.

References Cited

UNITED STATES PATENTS

1,773,067	8/1930	Ver Plank	277—1
2,924,467	2/1960	Burch	277—1
2,992,028	7/1961	Knox	277—1
3,249,363	5/1966	Chatfield	277—1

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29—401; 277—9, 59